Lloyd's Register

Rules and Regulations for the Classification of Ships, July 2008

Notice No. 9

Effective Date of Latest Amendments:

See page 1

Issue date: March 2009

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RULES AND REGULATIONS FOR THE CLASSIFICATION OF SHIPS, *July 2008*

Notice No. 9

This Notice contains amendments within the following Sections of the *Rules and Regulations for the Classification of Ships, July 2008.* The amendments are effective on the dates shown:

Part	***Chapter***	***Section***	***Effective date***
1	2	2	1 July 2009
1	3	2	1 July 2009
5	12	1, 2, 9, 10	1 July 2009
5	22	1, 2, 3	1 July 2009
6	1	2	1 July 2009
6	2	1, 10, 14, 16	1 July 2009
6	3	1, 2, 3, 7	1 July 2009
7	3	1, 4	1 July 2009
7	4	5	1 July 2009
7	9	1, 2, 3, 5	1 July 2009
7	15	1, 3, 4, 5, 6	1 July 2009
7	17	1, 2, 3, 4, 5, 6, 7	1 July 2009

It will be noted that the amendments also include corrigenda, which are effective from the date of this Notice.

The *Rules and Regulations for the Classification of Ships, July 2008* are to be read in conjunction with this Notice No. 9. The status of the Rules is now:

Rules for Ships	Effective date:	July 2008
Notice No. 1	Effective dates:	1 August 2008 & Corrigenda
Notice No. 2	Effective dates:	1 January 2009 &Corrigenda
Notice No. 3	Effective dates:	1 November 2008 & Corrigenda
Notice No. 4	Effective dates:	1 May 2007 & 1 July 2008
Notice No. 5	Effective dates:	1 January 2009 & Corrigenda
Notice No. 6	Effective dates:	1 January 2009 & Corrigenda
Notice No. 7	Effective date:	1 January 2009
Notice No. 8	Effective dates:	1 March 2009 & Corrigenda
Notice No. 9	Effective date:	1 July 2009

Part 1, Chapter 2
Classification Regulations

Effective date 1 July 2009

■ *Section 2* Character of classification and class notations

2.4 Class notations (machinery)

(Part only shown)

2.4.4 The following class notations are associated with navigation safety, and may be assigned as considered appropriate by the Committee:

IBS This additional notation will be assigned where an integrated bridge system is fitted to provide electronic chart display, track planning and automatic track following, centralised navigation information display, and bridge alarm management. It denotes that the integrated bridge system has been arranged, installed and tested in accordance with LR's Rules, or is equivalent thereto. For assignment of this notation, ~~the layout of the bridge and the equipment on the bridge are to satisfy the requirements for assignment of the notation **NAV1**. Where the layout of the bridge and the equipment located on the bridge satisfy the requirements of a relevant international or national ergonomic or human centred design standard or an acceptable equivalent, compliance with the requirements of **NAV1** may be relaxed.~~ in addition to satisfying LR Rules, or equivalent thereto, for navigational function integration:

(a) the layout of the bridge and the equipment located on the bridge is to satisfy the requirements of a relevant International or National Ergonomic or Human-centred Design Standard, or an acceptable equivalent, to the satisfaction of LR; or
(b) the notation **NAV1** is also to be assigned; or
(c) where the bridge is not intended to operate a periodic one man watch, the layout of the bridge and the equipment on the bridge are to satisfy the requirements for the assignment of the notation **NAV1** to the satisfaction of LR with the exception of requirements identified by LR Rules that may be relaxed in such cases.

Part 1, Chapter 3
Periodical Survey Regulations

Effective date 1 July 2009

■ *Section 2* Annual Surveys – Hull and machinery requirements

2.2 Annual Surveys

2.2.38 For **navigational arrangements for periodic one man watch**~~,~~ and ~~where applicable~~ **integrated bridge systems**, Annual Surveys are to be carried out in accordance with the approved test schedule as required by Pt 7, Ch 9,1.2.1 to ascertain that the equipment and arrangements required for the applicable class notation(s) are being maintained in good working order. At the time of the survey, relevant statutory certificates may be accepted as evidence of satisfactory operation.

Part 5, Chapter 12

Piping Design Requirements

Effective date 1 July 2009

■ *Section 1*
General

1.1 Application

1.1.3 The piping systems for LPG and LNG carriers, gas fuelled ships and classed refrigeration systems are to comply with the relevant Sections of this Chapter where applicable and the additional requirements in Section 9 as well as the requirements contained in the *Rules and Regulations for the Construction and Classification of Ships for the Carriage of Liquefied Gases in Bulk* (hereinafter referred to as the Rules for Ships for Liquefied Gases).

■ *Section 2*
Carbon and low alloy steels

2.9 Welded sleeve joints

2.9.5 The thickness of the sleeve is to satisfy the requirements of 2.2.3 and Table 12.2.4 but is to be not less than 1,42 times the nominal thickness of the pipe in order to satisfy the throat thickness requirement in 2.9.6. The radial clearance between the outside diameter of the pipe and the internal diameter of the sleeve is not to exceed 1 mm for pipes up to a nominal diameter of 50 mm, 2 mm on diameters up to 200 mm nominal size and 3 mm for larger size pipes. The pipe ends are to be separated by a clearance of approximately 2 mm at the centre of the sleeve.

■ *Section 9*
Piping for LPG/LNG carriers, gas fuelled ships and classed refrigeration systems

9.1 Scope

9.1.1 This Section is applicable to piping systems installed in LPG/LNG carriers, gas fuelled ships and classed refrigeration systems for the following pipes and piping system components:
(a) Pipework – stainless steel, carbon steel and copper.
(b) Valves – normal and cryogenic service (below minus 55°C).
(c) Bellows – normal and cryogenic service (below minus 55°C).
(d) Pipe fittings – elbows, reducers, tee connections, etc.
(e) Ancillary fittings – weldolets, threadolets, thermo-pockets.

9.1.2 The following piping systems are covered by this Section:
(a) LPG/LNG cargo systems – normal cargo operations.
(b) LPG/LNG cargo systems – cargo gas to reliquefaction system.
(c) LNG cargo systems – gas burning and use of cargo as fuel.
(d) LNG Regasification system – high and low pressure.
(e) Cargo Reliquefaction system – nitrogen or mixed refrigerant.
(f) Refrigeration – independent plant used in cascade systems.
(g) Gas storage and supply systems for gas fuelled ships.

9.2 Application

9.2.1 The requirements of this Section apply to pipes and piping system components, such as valves, elbows and bellows, which are to be used on gas carriers, gas fuelled ships or classed refrigeration/reliquefaction systems. The requirements are also applicable to other gas cargo services such as regasification systems and gas combustion units, and are in addition to those contained in both the *Rules and Regulations for the Construction and Classification of Ships for the Carriage of Liquefied Gases in Bulk* (hereinafter referred to as the Rules for Ships for Liquefied Gases) and relevant Sections of this Chapter where appropriate.

9.3 Classes of pipe

9.3.1 The material requirements for piping systems vary depending on the Class of the piping system. The Class of the piping system is dependent on the design pressure or temperature of the system and the pipe material used as shown in Table 12.1.1.

9.3.2 Table 12.1.1 piping systems containing LPG/LNG, cargo or fuel gas as the conveyed medium are to be treated as 'Flammable liquids'. These piping systems are to be categorised as Class II. Vapour lines are also to be categorised as Class II systems but the upper limit on pressure may be increased to 40 bar in accordance with the ‘Other media’. Where higher design pressures are applied, such as in a regasification system, liquid lines above 16 bar and vapour lines above 40 bar are to be categorised as Class I. All open ended pipes, such as vent lines and pipes inside the cargo tanks may be categorised as Class III.

9.3.3 For reliquefaction and refrigeration systems Table 12.1.1 is to be applied. Nitrogen and non-toxic or non-flammable refrigerants are to be considered under the ‘Other media’ heading. Refrigeration systems containing ammonia are to be considered as Class I systems irrespective of the operational pressure.

9.4 Materials

9.4.1 Stainless steel pipes, valves and fittings are to be grades 304L, 316L, 321 or 347 in accordance with Ch 6,5 of the Rules for Materials.

9.4.2 The materials used in Class I and Class II systems are to be produced at a works approved by LR. Testing is to be in accordance with the Rules for Materials and Tables 6.1 and 6.4 in Chapter 6 of the Rules for Ships for Liquefied Gases.

9.4.3 For stainless steel pipes, valve castings and forgings intended for service temperatures down to minus 55°C, a LR materials certificate is required unless the nominal diameter is less than 50 mm, or the nominal diameter is less than 150 mm and working pressure, in bar g, multiplied by nominal diameter, in mm, is less than 2500, where a manufacturer's material certificate is acceptable.

9.4.4 For pipe systems operating at cryogenic temperatures lower than minus 55°C, a LR materials certificate is required.

9.5 Valves and piping components independent of temperature

9.5.1 For valves and piping components fitted in the cargo piping system of LPG/LNG gas carriers, each type of valve and piping component is to have evidence of satisfactory type testing.

9.6 Valves for cryogenic temperature service

9.6.1 The tightness test required by Ch 5,5.3.2.1 of the Rules for Ships for Liquefied Gases is to be conducted in accordance with a recognised National or International Code or Standard.

9.7 Valves for refrigeration service

9.7.1 For valves intended for installation in a refrigeration system with a nominal diameter of less than 150 mm, a manufacturer's certificate is acceptable. The certificate is to include details of the maximum working pressure and test pressure, and sufficient information for the LR Surveyor to assess the suitability of the equipment for the intended use. Each size and type of valve is to be supplied with its own certificate and is to be signed by a responsible person in the manufacturer's quality control department.

9.7.2 Valves with nominal diameters above 150 mm are to be supplied with a LR materials certificate in accordance with the Rules for Materials.

9.7.3 Where valves are fitted to pressure vessels, the requirements of Chapters 10 and 11 are applicable for the Class of pressure vessel. Mountings for liquefied gas pressure vessels are to comply with the Rules for Ships for Liquefied Gases. Any acceptance of manufacturer's certification in other Sections of this Chapter is not applicable to the valves fitted to pressure vessels in Chapters 10 and 11 of the Rules for Ships for Liquefied Gases.

9.7.4 Any valve fitted directly onto a pressure vessel is to be considered a mounting and is required to be hydraulically pressure tested to twice the approved design pressure. *See* Ch 11,10.2.1.

9.8 Expansion bellows

9.8.1 The following plans and particulars are to be submitted:

(a) Dimensioned drawings of each type of bellows.

(b) Design calculations to show that the bellows are suitable for the intended design conditions, carried out to EJMA (Expansion Joint Manufacturers Association) standards (latest edition) or equivalent.

(c) A proposed prototype test program covering the tests detailed in Ch 5,5.3.2.2 of the Rules for Ships for Liquefied Gases.

(d) Calculations to EJMA standards may be accepted, together with sample testing detailed above, in order to cover the entire size range for the type.

9.8.2 In accordance with Ch 5,5.3 of the Rules for Ships for Liquefied Gases, the requirements for type testing in 9.8.3 to 9.8.7 are to be performed on each type of expansion bellows intended for use on LPG/LNG piping.

9.8.3 For each type of expansion bellows, an element of the bellows, not pre-compressed, is to be pressure tested at not less than five times the design pressure without bursting. This test is to be conducted at room temperature on each 'type' of element and need not be the complete bellows unit. A test on one element can cover other sized bellows with the same cross-sectional bellows form. The design pressure is to be at least 10 bar; bellows fitted to safety valves and vent lines may have a minimum design pressure of 5 bar in accordance with Ch 5,5.2.3.3 of the Rules for Ships for Liquefied Gases. The required test duration is not to be less than 5 minutes.

9.8.4 A pressure test is to be performed on each type of expansion joint complete with all the accessories such as flanges, stays and articulations, at twice the design pressure at the extreme displacement conditions recommended by the manufacturer without permanent deformation. The test is to be undertaken at the minimum design temperature, unless the bellows material is stainless steel for which this test may be carried out at ambient temperature. The test duration is to be 30 minutes unless otherwise agreed with LR.

9.8.5 A cyclic thermal movement test, replicating the cooling down and warming up cycle which occurs during cargo loading and discharge, is to be performed on a complete expansion joint, by the application of representative external deflection resulting in bellow movement. This is to successfully withstand at least as many cycles, under the conditions of pressure, temperature, axial movement, rotational movement and transverse movement, as it will encounter in actual service. The number of cycles is to be estimated by the builder and depends on the ship's intended trading pattern and life expectancy. As a minimum, testing to 7000 cycles is to be carried out. The test is to be carried out at between 2-5 cycles per second. Testing at ambient temperature is permitted when this testing is at least as severe as testing at the service temperature. The maximum movements on the horizontal and vertical axis are to be provided by the builders and obtained from their stress analysis; however, the test can be extended to any value which is greater than that expected, or to the maximum deflection for which the bellows unit is suitable. Movements in the test need not be in both horizontal and vertical directions; but the horizontal-vertical box diagonal distance may be used. NDE testing is required after cyclic testing.

9.8.6 A cyclic fatigue test, representing ship deformation, is to be performed on a complete expansion joint, without internal pressure, by simulating the bellows movement corresponding to a compensated pipe length, for at least 2,000,000 cycles at a frequency not higher than 5 cycles per second. The test may be waived if the piping arrangement, experiences ship deformation loads. NDE is required after cyclic testing.

9.8.7 The cyclic thermal movement test and cyclic fatigue test may be waived by LR if satisfactory documentation is provided to establish the suitability of the expansion joints to withstand the expected working conditions. Where the maximum internal pressure exceeds 1,0 bar gauge, this documentation is to include sufficient test data to justify the design method used, with particular reference to correlation between calculation and test results.

9.9 Pressure testing of piping and other piping components

9.9.1 Pressure testing is to be undertaken in accordance with specific Rule requirements relating to the system in which the component is to be located.

9.9.2 The duration for which pressure tests are to be held is to be in conjunction with an applicable and recognised code or standard acceptable to LR.

9.10 Equipment documentation

9.10.1 A certificate is required for each piping component supplied to be fitted in a Class I or Class II system. This certification is required for each size and type of equipment delivered. A single certificate may cover a number of valves, provided that they are of the same type and size, and serial numbers have been included on the certificate. If the piping components are part of a system fitted to a skid or packaged unit, then the complete skid may be supplied with a single certificate stating that the package has been constructed using approved materials, approved and tested in accordance with LR Rule requirements.

Existing Section 9 *is to be renumbered Section 10.*

Part 5, Chapter 22

Propulsion and Steering Machinery Redundancy

Effective date 1 July 2009

■ *Section 1*

General requirements

1.1 General

1.1.2 The requirements, which are optional, cover machinery arrangements and control systems necessary for ships which have propulsion and steering systems configured such that, in the event of a single failure of a system or item of active equipment, *see* 1.1.3, the ship will retain ~~not less than 50 per cent of~~ the ability to use available installed prime mover capacity and ~~not less than 50 per cent of the~~ installed propulsion systems that are unaffected by the failure. The ship is also to ~~and~~ retain steering capability at a service speed of not less than seven knots. ~~100 per cent propulsion power is the approved total power of all the main propulsion units at maximum continuous rating (MCR).~~ The requirements also cover machinery arrangements where the propulsion and steering systems are installed in separate compartments such that, in the event of a loss of one compartment, the ship will retain availability of propulsion power and manoeuvring capability.

1.1.5 Sections 2, 3 and 4 state the applicable requirements for arrangements necessary to maintain availability of propulsion and manoeuvring capability, in the event of a single failure in equipment. Ships complying with the applicable requirements of Sections 2 to 4 of this Chapter will be eligible for the machinery class notation **PMR** or **PMRL**(Propulsion Machinery Redundancy), **SMR** or **SMRL**(Steering Machinery Redundancy) or **PSMR** or **PSMRL**(Propulsion and Steering Machinery Redundancy), which will be recorded in the *Register Book*.

NOTE
The additional **L** character to **PMR**, **SMR** and **PSMR** notations indicates a limited capability.

1.1.6 Section 5 states the additional requirements necessary to maintain availability of propulsion and manoeuvring capability where machinery is installed in separate compartments and the loss of any one compartment due to fire or flooding has been addressed. Ships complying with the applicable requirements of Sections 2 to 5 of this Chapter will be eligible for the machinery class notation **PMR★** or **PMRL★** (Propulsion Machinery Redundancy in separate machinery spaces), **SMR★** or **SMRL★** (Steering Machinery Redundancy in separate machinery spaces) or **PSMR★** or **PSMRL★** (Propulsion and Steering Machinery Redundancy in separate machinery spaces) which will be recorded in the *Register Book*.

1.1.7 For assignment of **PSMR** or **PSMR★** machinery class notations, the ship is to retain the ability to use not less than 50 per cent of the installed prime mover capacity and not less than 50 per cent of the installed propulsion systems and retain steering capability at a service speed of not less than seven knots in the event of a single failure of a system or item of equipment.

1.1.8 Where the ship does not comply with 1.1.7 but can retain a service speed of not less than seven knots using available installed prime mover capacity and propulsion systems (which may be less than 50 per cent) following a failure of a system or item of equipment, machinery class notations **PSMRL** or **PSMRL★** may be assigned. The available installed prime mover capacity and installed propulsion systems are to be identified and included in 1.2.7.

1.2 Plans and information

1.2.4 **Manoeuvring capability**. An assessment of the ship's ahead and astern manoeuvring capability, under the following operating conditions, is to be submitted:

(a) Where only 50 per cent or less of the installed prime mover capacity and ~~not less than~~ 50 per cent or less of the installed propulsion systems are available.
(b) Where the steering capability requirements described in 3.2.1 are available.

~~IMO Resolution A.751(A) *Interim Standards for Ship Manoeuvrability*, provides guidance on standard manoeuvres required in an assessment of the manoeuvrability of ships.~~ IMO Resolution MSC 137(76) – *Standards for Ship Manoeuvrability*, provides guidance, on standard manoeuvres required in an assessment of the manoeuvrability of ships.

~~*1.2.7* The FMEA is to establish that in the event of a single component failure, for ships assigned:~~

~~(a) **PSMR** and **PSMR★** notations, at least 50 per cent of the propulsion power and steering capability remains available;~~
~~(b) **PMR** and **PMR★** notations, at least 50 per cent of the propulsion power remains available; and~~
~~(c) **SMR** and **SMR★** notations, the steering capability remains available.~~

1.2.7 **Installed prime mover capacity and installed propulsion systems**. A schedule of the propulsion systems and their operating capacity and capability under normal and foreseeable failure conditions is to be submitted.

■ *Section 2*
Failure Mode and Effects Analysis (FMEA)

2.1 General

2.1.7 The FMEA is to establish that ~~following~~ in the event of a single component failure:

(a) for **PSMR** and **PSMR★** notations, that the ship will retain not less than 50 per cent of the installed prime mover capacity and not less than 50 per cent of the installed propulsion systems and retain steering capability;
(b) for **PMR** and **PMR★** notations, that the ship will retain not less than 50 per cent of the installed prime mover capacity and not less than 50 per cent of the installed propulsion systems; ~~and~~
(c) for **SMR** and **SMR★** notations, that the steering capability remains available~~.~~ ;
(d) For **PSMRL★** notation, that the ship will retain the ability to use available installed prime mover capacity and installed propulsion systems that are not directly affected by the failure and retain steering capability at a service speed of not less than seven knots; and
(e) For **PMRL★** notation, that the ship will retain the ability to use available installed prime mover capacity and installed propulsion systems that are not directly affected by the failure.

■ *Section 3*
Machinery arrangements

3.1 Main propulsion machinery

3.1.2 For **PMRL**, **PSMRL**, **PMRL★** and **PSMRL★** notations, independent main propulsion systems are to be provided so that there remains the ability to use the remaining available installed prime mover capacity and installed propulsion systems following a single failure of a system or item of equipment. In the event of a single failure in equipment, the remaining system(s) is to be capable of maintaining a manoeuvring speed and, for **PSMRL** and **PSMRL★** notations, give adequate manoeuvring capability, *see* 1.2.4.

3.3 Electrical power supply

3.3.2 In the event of the loss of one section or failure of the power supply from one generator, there is to be continuity of sufficient electrical power to supply essential services such that the available installed prime mover capacity and installed propulsion systems will continue to have the ability of functioning at their operational capability where **PSMRL**, **PSMRL★**, **PMRL and PMRL★** notations are required. *See* 3.2.1 for steering machinery requirements.

Existing paragraphs 3.3.2 *to* 3.3.4 *are to be renumbered* 3.3.3 *to* 3.3.5.

Part 6, Chapter 1

Control Engineering Systems

Effective date 1 July 2009

■ *Section 2*
Essential features for control, alarm and safety systems

2.4 Safety systems, general requirements

2.4.1 Where safety systems are provided the requirements of 2.4.2 to 2.4.13 are to be satisfied. The requirements of this sub-Section apply, where relevant, to the safety systems installed on the equipment defined in 1.2.3, including those provided in addition to those safeguards required by Section 3 or other Sections of the Rules.

2.9 Fixed water-based local application fire-fighting systems

2.9.3 The activation of a system is not to result in loss of electrical power or reduction of the manoeuvrability of the ship and is not to require confirmation of space evacuation or sealing, *see also* Ch 2,16.3.12.

2.9.4 System zones and protected areas are to be arranged to allow essential services to be provided by machinery and/or equipment located outside areas affected by direct spray or extended water in the event of a system activation, where the machinery and/or equipment is duplicated or otherwise replicated to provide redundancy.

~~*2.9.4*~~ *2.9.5* A control panel is to be provided for managing actions such as opening of valves, starting of pumps and sounding of alarms and processing information from detectors. This panel is to be independent of the fire detection control unit required by 2.8.

Existing paragraph 2.9.5 *is to be renumbered* 2.9.6.

2.9.7 A failure in a manual system activation switch circuit is not to prevent system activation using other installed manual system activation switches or, where installed, automatic activation. The means of activation are to be provided with self-monitoring facilities which will activate an alarm at an attended control station in the event of failure detection.

Existing paragraph 2.9.6 *is to be renumbered* 2.9.8.

~~*2.9.7*~~ *2.9.9* A minimum of two fire detectors ~~is~~ are to be provided for each protected area. One is to be a flame detector and the other is to be a smoke or heat detector, as considered appropriate to the nature of the risk and ambient conditions. The system is to be activated upon detection by two of the detectors. A fault in one detector is to initiate an alarm at an attended control station and is not to inhibit activation of the system under the control of the other detector or manually.

2.9.10 The fire detectors are to be arranged (located, oriented, guarded, etc.) to ensure that a fire in one protected area will not result in the inadvertent automatic activation of a system for another protected area. Guards or barriers provided to comply with this requirement are not to reduce the ability to detect a fire in the protected area.

Existing paragraph 2.9.8 *is to be renumbered* 2.9.11.

~~*2.9.9*~~ *2.9.12* The system's fire detection systems and control units are to meet the performance criteria of SOLAS Ch II/C, Reg. 7 and ~~satisfy the requirements of LR's *Type Approval System*~~ are to be Type Approved in accordance with *Test Specification Number 1* ~~*(2002)*~~ given in LR's *Type Approval System* for an environmental category appropriate for the locations in which they are intended to operate.

Part 6, Chapter 2

Electrical Engineering

Effective date 1 July 2009

■ *Section 1*
General requirements

1.2 Plans

1.2.8 Details of electrically-operated fire, ship, crew and passenger emergency safety systems which are to include typical single line diagrams and arrangements, showing main vertical and, where applicable, horizontal fire zones and the location of equipment and cable routes, including identification of relevant high risk fire areas, to be employed for:

(a) emergency lighting;
(b) accommodation fire detection, alarm and extinction systems;
(c) ~~Fixed~~ fixed water-based local application fire-fighting systems;
(d) public address system;
(e) general alarm;
(f) watertight doors, bow, stern and shell doors and other electrically operated closing appliances~~.~~ ; and
(g) low location lighting.

NOTE
A general arrangement plan of the complete ship showing the main vertical fire zones and the location of equipment and cable routes, including identification of relevant high risk fire areas, for the above systems, is to be made available for the use of the Surveyor on board.

1.2.9 Evidence of the suitability of electrical and electronic equipment for use in protected areas and adjacent areas, as required by 16.3.11 and 16.3.12, including a schedule of electrical and electronic equipment located in protected areas and adjacent areas, and general arrangement plans showing the coverage of the protected areas and adjacent areas.

Existing paragraphs 1.2.9 *to* 1.2.11 *are to be renumbered* 1.2.10 *to* 1.2.12.

~~*1.2.12*~~ *1.2.13* ~~Plans~~ General arrangement plans showing the location of propulsion generators, motors, ~~converting equipment~~ transformers, semiconductor converters, dynamic braking equipment, reactors and filters. The information supplied is also to include cable routes to show compliance with 10.8, as applicable.

~~*1.2.13*~~ *1.2.14* ~~For~~ Plans for all cables that pass through atria or equivalent spaces, and for vertical runs in trunks or other restricted spaces~~, the~~. The information supplied is to show compliance with 10.8.8.

Existing paragraphs 1.2.14 *to* 1.2.17 *are to be renumbered* 1.2.15 *to* 1.2.18.

1.3 Surveys

1.3.3 For electric propulsion systems, in addition to the equipment listed in 1.3.2, the following equipment is to be surveyed by the Surveyors during manufacture and testing:

- ~~cables;~~
- exciters;
- filters;
- reactors;
- dynamic braking assemblies; and
- slip ring assemblies.

1.4 Additions or alterations

1.4.4 Where it is intended to replace an existing incandescent lamp type navigation light with a light emitting diode type navigation light, details are to be submitted for consideration that demonstrate compliance with 14.5. Light emitting diode type navigation lights failure detection arrangements are to satisfy the requirements of 14.5.4 and 14.5.5.

1.10 Location and construction

1.10.6 The minimum creepage and clearance distances provided for electrical connections, terminals and similar bare live parts are to be in accordance with a relevant International or National Standard for the equipment or apparatus concerned. In cases where the rated voltage is outside that given in the Standard or where no Standard is available, the minimum creepage and clearance distances provided are to be in accordance with 7.5. Details of alternatives proposals including supporting design rationale and demonstration may be submitted for consideration.

Existing paragraphs 1.10.6 *to* 1.10.11 *are to be renumbered* 1.10.7 *to* 1.10.12.

■ *Section 10*

Electric cables and busbar trunking systems (busways)

10.1 General

10.1.3 Electric cables for electric propulsion systems are to be Type Approved in accordance with LR’s *Type Approval System Test Specification Number 3* or, alternatively, surveyed by the Surveyors during manufacture and testing to assess compliance with the applicable International or National Standards and application of an acceptable quality management system.

Existing paragraphs 10.1.3 *to* 10.1.5 *are to be renumbered* 10.1.4 *to* 10.1.6.

10.5 Construction

10.5.5 ~~Electric cables where it is required that their construction~~ Where it is required that the construction of electrical cables includes metallic sheaths, armouring or braids are to be provided with an overall impervious sheath or other means to protect the metallic elements against corrosion, *see also* 10.8.7 and 10.8.8.

10.5.6 Where cables are installed in an area where contamination by oil is likely to occur, the oversheath is to be of an enhanced oil resistance grade.

Existing paragraphs 10.5.6 *to* 10.5.8 *are to be renumbered* 10.5.7 *to* 10.5.9.

10.8 Installation of electric cables

10.8.7 Cables having a bare metallic screen, braid or armour are to be installed in such a manner that galvanic corrosion by contact with other metals is prevented. Sufficient measures are also to be taken to prevent damage to any bare galvanised coatings during installation.

10.8.8 Consideration is to be given to providing adequate protection for cable oversheaths in areas where cables are likely to be exposed to damaging substances under normal circumstances or areas where the spillage or release of harmful substances is likely.

Existing paragraphs 10.8.7 *to* 10.8.19 *are to be renumbered* 10.8.9 *to* 10.8.21.

■ *Section 14*
Navigation and manoeuvring systems

14.5 Navigation lights

14.5.4 For navigation lights using light emitting diodes (consisting of multiple light sources) means to ensure that the overall luminous intensity of the navigation light is sufficient are to be provided in addition to the alarm to indicate the complete loss of the navigation light illumination required by 14.5.3. For replacement navigation lights, *see* 1.4.4.

14.5.5 To satisfy 14.5.4, an audible and visual alarm is to be activated to notify the Officer of the Watch when the luminous intensity of the light reduces below the level required by the IMO *Convention on the International Regulations for Preventing Collisions at Sea*. Alternative measures to ensure continuing acceptable performance of navigation lights using light emitting diodes may be considered that are in accordance with:

- IMO Res. MSC.253(83), *Performance Standards for Navigation Lights, Navigation Light Controllers and associated Equipment*, and
- EN 14744, *Inland navigation vessels and sea-going vessels – Navigation light*, or a relevant National or International Standard.

Where alternative measures are proposed that require verification by personnel of the luminous intensity of navigation lights using light emitting diodes, details of the inspection implementation in the ship's safety management system and acceptance by the National Administration are to be submitted for consideration.

Existing paragraphs 14.5.4 *and* 14.5.5 *are to be renumbered* 14.5.6 *and* 14.5.7.

■ *Section 16*
Fire safety systems

16.1 Fire detection and alarm systems

16.1.3 ~~The fire~~ Fire detection systems within the accommodation spaces ~~is~~ and cabin balconies are, in addition to the requirements of Ch 1,2.8.4, 2.8.6, 2.8.8 and 2.8.10 to 2.8.14, to comply with 16.1.4 to 16.1.15.

16.1.16 Where it is intended that detectors be installed in external locations, e.g. cabin balconies, in addition to meeting the requirements for an environmental category suitable for open decks (*see* Ch 1,2.8.8), they are also to be tested for sun irradiation and ultraviolet exposure with satisfactory results.

16.3 Fixed water-based local application fire-fighting systems

16.3.1 Where fixed water-based local application fire-fighting system pressure sources are reliant on external power they need only be supplied by the main source of electrical power. ~~However, where the system forms a section of the main fixed fire extinguishing system the power supply arrangements are to be equivalent to those required by 16.2.2.~~

16.3.4 Means to activate a system are to be located at easily accessible positions inside and outside the protected space. Arrangements inside the space are to be situated such that they will not be cut off by a fire in the protected areas and are suitable for activation in the event of escape. ~~Proposals to install local activation means outside protected spaces are to be submitted for consideration.~~ Where it is proposed to install local activation means outside of the protected space, details are to be submitted for consideration.

16.3.5 For the electrical safety of electrical and electronic equipment in areas protected by fixed water-based local application fire-fighting systems and adjacent areas where water may extend, the requirements of 16.3.6 to ~~16.3.8~~ 16.3.10 apply.

16.3.6 ~~Unless essential for safety or operational purposes, electrical and electronic equipment is not to be located within protected areas or adjacent areas.~~ As far as is practicable, electrical and electronic equipment is not to be located within protected areas or adjacent areas. The system pump, its electrical motor and the sea valve if any, may be in a protected space provided that they are outside areas where water or spray may extend.

~~*16.3.7* Electrical and electronic equipment located within protected areas and those within adjacent areas exposed to direct spray are to have a degree of protection not less than IP44.~~

~~*16.3.8* Electrical and electronic equipment within adjacent areas not exposed to direct spray may have a lower degree of protection than IP44 provided evidence of suitability for use in these areas is submitted, including details of the design and equipment layout and arrangements to prevent or restrict the ingress of water mist/spray. Cooling airflow for equipment is to be assured.~~

16.3.7 High voltage equipment and their enclosures are not to be installed in protected areas or adjacent areas. For high voltage generators enclosures which cannot be fully located outside of adjacent areas due to close proximity, a technical justification, including proposed degree of protection ratings that are normally not to be lower that IP54, may be submitted for consideration that demonstrates the overall safety of the installation in the event of system operation.

16.3.8 In addition to the degree of protection requirements of 1.10.1, electrical and electronic equipment enclosures located within protected areas and within adjacent areas are to provide adequate protection in the event of system operation.

16.3.9 To demonstrate compliance with 16.3.8, evidence of the suitability of electrical and electronic equipment for use in protected areas and adjacent areas is to be submitted in accordance with 1.2.9. The evidence is to demonstrate that additional precautions have been taken, where necessary, in respect of:

(a) satisfying 16.3.6 and 16.3.7;
(b) personnel protection against electric shock;
(c) cooling airflow, where necessary, for equipment required to operate during system operation; and
(d) maintenance requirements for equipment before return to operation following system activation.

Any test evidence submitted is to consider the overall installation, including equipment types, system configuration and nozzles and the potential effects of airflows in the protected space.

16.3.10 The evidence required by 16.3.9 is to demonstrate the safe and effective operation of the overall arrangements in the event of system operation. This evidence is to demonstrate that exposure to system spray and/or water:

- cannot result in loss of essential services (i.e. unintended activation of automatic machinery shut-down due to sensor failure);
- cannot result in loss of availability of emergency services;
- will not affect the continued safe and effective operation of electrical and electronic equipment required to operate during the required period of system operation;
- does not present additional electrical or fire hazards; and
- would require only identified readily replaceable components to be repaired or replaced.

The installation of electrical and electronic equipment required to provide essential or emergency services in enclosures with a degree of protection less than IP44 within areas exposed to direct spray is to be acceptable to LR, and evidence of suitability is to be submitted accordingly.

16.3.11 Fixed water-based local application fire-fighting system electrically-driven pumps may be shared with:

- equivalent automatic sprinkler systems;
- equivalent main machinery space fire-fighting systems; or
- local fire-fighting systems for deep-fat cooking equipment;

provided that the shared use is accepted by the National Administration as complying with applicable statutory regulations and the arrangements comply with the requirements of 16.3.12 to 16.3.14.

16.3.12 Shared electrically-driven sea-water pumps are to be served by not less than two circuits reserved solely for this purpose, one fed from the main source of electrical power and one from the emergency source of electrical power. Such feeders are to be connected to an automatic changeover switch situated near the pumps and the switch is to be normally closed to the feeder from the main source of electrical power. No other switches are permitted in the feeders. The switches on the main and emergency switchboards are to be clearly labelled and normally kept closed.

16.3.13 Failure of a component in the power and control system is not to result in a reduction of the total available pump capacity below that required by any of the areas which the system is required to protect. For equivalent automatic sprinkler systems, a failure is not to prevent automatic release or reduce sprinkler pump capacity by more than 50 per cent.

16.3.14 Where fire-fighting systems share fire-fighting pumps, failure of one system is not to prevent activation of the pumps by any other system.

16.6 Fire safety stops

16.6.6 In passenger ships carrying more than 36 passengers, exhaust ducts from main laundries are to be fitted with additional remote-control arrangements for shutting off the exhaust fans and supply fans from within the space and for operating fire dampers fitted at the lower end of the duct.

Existing paragraphs 16.6.6 *to* 16.6.9 *are to be renumbered* 16.6.7 *to* 16.6.10*.*

16.8 Fire dampers

16.8.3 In passenger ships carrying more than 36 passengers, fire dampers fitted at the lower end of exhaust ducts from main laundries are to be capable of automatic and remote operation.

16.10 Safety centre on passenger ships

16.10.1 Passenger ship safety centres required by SOLAS Ch II/2, Reg. 23 to provide a control station dedicated to assist with the management of emergency situations are to satisfy the requirements of this sub-Section.

16.10.2 The safety centre is to be either a part of the navigation bridge or to be located in a separate adjacent space having direct access to the navigation bridge.

16.10.3 Except where located in the same space, means of communication between the safety centre, the central control station, the navigation bridge, the engine control room, the storage room(s) for fire extinguishing system(s) and fire equipment lockers are to be provided.

16.10.4 The operation, control and monitoring of the following arrangements, where they are required to be installed by the National Administration, is to be additionally available from the safety centre:

- all powered ventilation systems;
- fire doors;
- general emergency alarm system;
- public address system;
- electrically powered escape route lighting or low location lighting for evacuation guidance;
- watertight and semi-watertight doors;
- indicators for bow and inner doors and stern and side shell doors and their closing appliances;
- water ingress detection for bow and inner doors and stern and side shell doors;
- remote surveillance systems for bow and inner doors and stern and side shell doors;
- fire detection and alarm systems;
- fixed water-based local application fire-fighting systems;
- automatic sprinkler systems, or equivalents;
- water-based fixed fire-extinguishing systems for machinery spaces;
- alarm to summon the crew;
- atrium smoke extraction system;

- flooding detection systems; and
- fire pumps and emergency fire pumps.

Operation, control and/or monitoring facilities provided at the safety centre are additional to any dedicated facilities required at other locations by the Rules or the National Administration.

16.10.5 Where arrangements are operated, controlled and/or monitored from the safety centre in accordance with 16.10.4, they are to comply with the relevant requirements of Pt 6, Ch 1,2 in respect of control, alarm and programmable electronic systems.

Part 6, Chapter 3

Refrigerated Cargo Installations

Effective date 1 July 2009

■ *Section 1* General requirements

1.1 Application

1.1.4 The requirements for the refrigeration equipment and systems necessary for provision stores and air conditioning are specified in Pt 7, Ch 17.

■ *Section 2* Design criteria

2.5 Design pressures

2.5.5 Design pressures (bar g) applicable to refrigerants are to be not less than the values given in Table 3.2.2 when condensers are sea-water cooled. The design pressure for other refrigerants and condensing arrangements is to be agreed with LR.

■ *Section 3* Refrigerating machinery and refrigerant storage compartments

3.3 Gas storage compartments

3.3.4 The compartment is to be provided with a refrigerant vapour detection system.

■ *Section 7* Instrumentation, control, alarm, safety and monitoring systems

7.2 Control, alarm and safety systems

7.2.1 Where the refrigerating system is fitted with automatic or remote controls, so that under normal operating conditions ~~it does not require any~~ no manual intervention by the operators is required, it is to be provided with the alarms required by 7.2.2 and 7.2.3 in accordance with the relevant requirements of Chapter 1.

Part 7, Chapter 3

Fire-fighting Ships

Effective date 1 July 2009

■ *Section 1* General

1.4 Submission of plans

(Part only shown)

1.4.1 The following plans and information are to be submitted:

- A plan of the construction of the fire doors.
- Plans showing the layout and capacity of the water spray system. Where alternative arrangements to those specified in 4.2 are proposed, evidence is to be submitted to satisfactorily demonstrate that an equivalent level of protection from radiated heat is provided, including details of the environmental conditions in which the ship is intended to operate, *see* 4.2.1.
- A plan of the seating arrangements for the water monitors.

■ *Section 4*

Fire protection

4.2 Water spray systems

4.2.1 Ships which are intended to operate in close proximity to a large fire will require protection from the heat radiated from the fire. Such protection may be afforded by a system which provides a water spray over the surface of the ship, or by a combination of insulation and a water spray system. Alternative arrangements providing an equivalent level of protection may be accepted where it can be demonstrated that such arrangements are effective for the environmental conditions in which the ship is intended to operate.

Part 7, Chapter 4

Dynamic Positioning Systems

Effective date 1 July 2009

■ *Section 5*

Class notation DP(AAA)

5.1 Requirements

5.1.6 Where duplicated cables and pipes for services essential for the correct functioning of the DP system are installed in adjacent compartments, A-60 rated fire protection is to be provided between the spaces. Details of alternative arrangements which demonstrate essential equipment located in an adjacent space will continue to operate satisfactorily and essential services will continue to be available in the event of a fire in the adjacent space may be submitted for consideration.

Existing paragraphs 5.1.6 *to* 5.1.12 *are to be renumbered* 5.1.7 *to* 5.1.13*.*

Part 7, Chapter 9

Navigational Arrangements ~~for Periodic One Man Watch~~ and Integrated Bridge Systems

Effective date 1 July 2009

■ *Section 1*

General requirements

1.1 General

1.1.1 The requirements of this Chapter apply to ships where an optional class notation for optimizing environment on the bridge for navigational tasks, including periodic operation of the ship under the supervision of a single watchkeeper on the bridge and/or integrated bridge systems, is requested, and are additional to those applicable in other Parts of the Rules.

1.1.5 In general, ships complying with the requirements of Sections 1 to 4 of this Chapter will be eligible for the notation **NAV1**.

1.1.6 Section 5 of this Chapter states additional requirements which apply where the navigational functions are integrated. In general, ships complying with the requirements of Section 5 will be eligible for the notation **IBS**, *see* Pt 1, Ch 2,2.4. In addition to the assessment of the navigational function integration, the assignment of the notation **IBS** requires that the layout of the bridge and the equipment located on the bridge is to the satisfaction of LR, *see* 5.2.1.

Section 2
Physical conditions

2.1 Bridge and wheelhouse arrangement

2.1.8 Toilet facilities are to be provided on the bridge or adjacent to the bridge on the bridge deck.

Section 3
Workstations

3.1 Navigation workstation

(*Part only shown*)
3.1.4 The following facilities are to be provided at the navigation workstation:

- Automatic ship identification system (AIS) information.
- Sound reception system where fitted, *see* 2.2.8.
- Means to cease the distribution of long-range identification and tracking information, where required by SOLAS Ch V, Reg.19-1,7.

3.1.7 A gyrocompass or alternative means for determining, displaying and transmitting the ship's heading by shipborne, non-magnetic means, is to be provided and is to be clearly readable by the helmsman at the main steering position. The heading information is to be used directly by the radars, radar plotting aids and automatic identification system, *see* 3.1.5 and 3.1.13. The gyrocompass is to be provided with a gyrocompass heading repeater located at the emergency steering position in the steering gear compartment and a gyrocompass bearing repeater allowing bearings to be taken over 360°.

Section 5
Integrated Bridge Navigation System – IBS notation

5.2 General requirements

~~*5.2.1* For assignment of the notation **IBS**, the layout of the bridge and the equipment on the bridge are to satisfy the requirements for assignment of the notation **NAV1** (Sections 1 to 4). Where the layout of the bridge and the equipment located on the bridge satisfy the requirements of a relevant international or national ergonomic or human centred design standard or an acceptable equivalent, compliance with the requirements of Sections 1 to 4 may be relaxed.~~

5.2.1 For assignment of the notation **IBS**, in addition to satisfying the other requirements of this Section:

(a) the layout of the bridge and the equipment located on the bridge is to satisfy the requirements of a relevant international or national ergonomic or human-centred design standard or an acceptable equivalent; or

(b) the notation **NAV1** is also to be assigned and the layout of the bridge and the equipment on the bridge are to satisfy the requirements Sections 1 to 4; or

(c) where the bridge is not intended to operate a periodic one man watch, the layout of the bridge and the equipment on the bridge are to satisfy the requirements of Sections 1 to 4, with the exception that the requirements of 4.2 and 4.3 may be relaxed.

5.2.2 Where 5.2.1(a) is applicable, the submissions required by 1.2.1 are to include evidence demonstrating satisfaction of the requirements of an identified relevant standard.

5.2.3 To satisfy 5.2.2, the evidence submitted is to:

(a) be submitted to LR for assessment, including identification of testing necessary to verify compliance in the submitted test schedules; or

(b) include relevant statutory documentation demonstrating compliance with the relevant identified standard to the satisfaction of the National Administration. Such documentation is to be submitted prior to the assignment of the **IBS** notation. This may necessitate co-ordination of classification and statutory Surveys, particularly for new construction, before the **IBS** notation may be assigned.

5.2.4 Where 5.2.1(c) is applicable, the submissions required by 1.2.1 are to include plans and information for the consideration of LR which demonstrate that the applicable requirements of Sections 1 to 4 have been satisfied.

Existing paragraphs 5.2.2 *and* 5.2.3 *are to be renumbered* 5.2.5 *and* 5.2.6.

5.3 Equipment

5.3.8 The centralized alarm system and the watch safety system required by 4.1 and 4.2 respectively are to be incorporated as functions of the integrated bridge system and are to be presented to the navigating officer via the conning display. The presentation and display of alarms is not to mask, obscure or degrade essential information displayed to aid navigational functions and maintain awareness of the navigational information, *see also* 5.5.

Part 7, Chapter 15

On-shore Power Supplies

Effective date 1 July 2009

■ *Section 1* General

1.4 Plans and information

1.4.2 Operating Manuals that describe the intended methods of connection together with operating and monitoring instructions. Assessments of the external supplies that are to be connected to the ship together with the mooring and environmental conditions are to be included. Details of equipment and arrangements necessary to ensure safety when connecting, disconnecting, transferring electrical load, testing and operating are to be incorporated.

■ *Section 3* Electrical connection

3.1 General

(Part only shown)
3.1.10 Requirements for an external electrical power supply to be connected are to be defined in the Design Statement and ~~a notice is to be provided at the connection cubicle indicating~~ this is to detail the following:

- ~~reference to the Operating Manuals;~~
- isolation and earthing; and
- supply requirements for lightning and surge protection, galvanic isolation of supply circuit from other ships, etc.

~~The Notice is to align with the Design Statement and Operating Manuals. *See* 1.1.4 for the conducting of the assessment of overall compatibility.~~ Required electrical characteristics are to address steady state, transient and fault conditions, as necessary.

3.1.11 A notice is to be provided at the connection cubicle referencing the Operating Manuals and Design Statement and advising of the requirement to ensure that external electrical power supplies satisfy the requirements of 3.1.10 prior to connection. *See* 1.1.4 for the conducting of the assessment of overall compatibility.

3.2 Connection Equipment

~~*3.2.7* Connections with external electrical power supply arrangements are to be designed to separate (break away) at a tension higher than that required for normal operation but lower than the rating of the affected Connection Equipment to prevent damage to the ship structure or Connection Equipment, other than defined damage to break-away equipment (for example, shear bolts to be replaced). Evidence of compliance with this requirement is to be included in the submission required by 1.4.3.~~

3.2.7 Connections with external electrical power supply arrangements are to be designed to prevent damage to the ship structure or Connection Equipment cable reels, cranes and/or gantries as a result of the connections separating in the event of the ship leaving a berth inadvertently or as a result of high cable tension for other reasons. Evidence of compliance with this requirement is to be included in the submission required by 1.4.3 and is to identify Connection Equipment (weak points) that will be damaged, if any, in the event of separation. Damage to connection cables, plugs and socket-outlets or other identified equipment may be considered.

3.3 Connection cables, plugs and socket-outlets

3.3.3 Plugs and socket-outlets are to have provisions for connection to be made such that no strain is transmitted to the terminals and contacts. They are to be so designed such that when in place they will be held in positive contact ~~and locked in position~~.

3.3.4 Plugs and socket-outlets are to be provided with means of locking together in the connected position.

Existing paragraphs 3.3.4 *to* 3.3.7 *are to be renumbered* 3.3.5 *to* 3.3.8.

Table 15.3.1 Type tests for external power supply connection plugs and socket-outlets
(*Part only shown*)

NOTE~~S~~
~~1.~~ After conducting the tests above, the temperature rise test, lightning impulse withstand test and high voltage test should be repeated.
~~2. Details of arc testing conducted in accordance with a relevant standard are to be submitted for consideration that verify that safety will be ensured in the intended connection location(s).~~

3.3.9 Power connection plugs and socket-outlets are to be constructed and located to minimise the potential of arc flash hazards and suitable warning notices are to be provided at locations along Connection Equipment routes, including power connection plugs and socket-outlets operational locations.

Existing paragraph 3.3.8 *is to be renumbered* 3.3.10.

■ *Section 4* Electrical system

4.1 Electrical load transfer

4.1.6 The Transfer Time Limit referred to in 4.1.5 may be adjustable to match the ability of an external electrical power supply to accept and shed load. Setting of the Transfer Time Limit is to be demonstrated to the attending Surveyor at Surveys and Trials, *see* 6.1.

■ *Section 5*
Control and monitoring

5.2 Connection Equipment control and monitoring

~~*5.2.6* An alarm is to be provided at a machinery control station that is attended when connected to an external electrical power supply when Connection Equipment approaches a situation where it may be submerged in the water between the ship and shore, for instance due to tidal changes. The time between alarm initiation and possible exposure to this water is to be sufficient to allow the equipment to be attended and adjusted prior to exposure to water. Where alternative equivalent arrangements are proposed (for example, submersible equipment, equipment routing or slack cable prevention by torque control), details are to be submitted for consideration.~~

5.2.6 Where correctly applied connection equipment is not protected from submersion in the water between the ship and shore (e.g. submersible equipment, equipment routing or slack cable prevention by torque control), an alarm is to be provided at a machinery control station that is attended when connected to an external electrical power supply when Connection Equipment approaches a situation where it may be submerged in the water between the ship and shore, for instance due to tidal changes. The time between alarm initiation and possible exposure to this water is to be sufficient to allow the equipment to be attended and adjusted prior to exposure to water.

5.3 Emergency Shut-Down

5.3.2 Emergency Shut-Down facilities are to be provided that, when activated, will instantaneously:

- isolate the connection from ship electrical power supplies; and
- request isolation of the external electrical power supply connection points.

~~For high-voltage connections, the Connection Equipment power connections are to be discharged so that they are safe to touch following isolation from ship and shore electrical power supplies before power conductors are exposed.~~

5.3.3 For high-voltage connections, the Connection Equipment power connections are also to be discharged so that they are safe to touch following the isolation from ship and shore electrical power supplies required by 5.3.2 in as short a time as practicable. Where earthing of connecting external equipment by ship equipment would not be permitted by the authorities responsible for the external equipment, details are to be submitted prior to connection for consideration. The submission is to detail alternative proposals for personnel protection and Connection Equipment power conductors discharge in the event of activation of the

~~*5.3.3*~~ *5.3.4* Means are to be provided to detect or predict tension in the external electrical power supply connection cable ~~are to be provided and~~ that activate the Emergency Shut-Down facilities described in 5.3.2 before damage occurs~~, these arrangements are to activate the Emergency Shut-Down facilities described in 5.3.2~~. Where alternative arrangements to tension detection are proposed (automatic break-away release, connectors with shear bolts and pilot lines, connection with ship/shore Emergency Shut-Down system, etc.), details are to be submitted for consideration.

~~*5.3.4*~~ *5.3.5* To ~~prevent~~ detect and react to the withdrawal of plugs from socket-outlets while power supply connections are live, the Emergency Shut-Down facilities described in 5.3.2 are to be activated before the necessary degree of protection is no longer achieved or power connections are broken by the removal of a plug from a connected socket-outlet, including in-line connections.

5.3.6 For high-voltage connections where the means of locking together plugs and socket-outlets required by 3.3.4 are not interlocked to prevent removal from the locked position when the Connection Equipment power connections are not discharged so that they are safe to touch, the Emergency Shut-Down facilities described in 5.3.2 are to be activated when connected plugs are moved from the locked position. Consideration may be given to relaxing this requirement when evidence is submitted which demonstrates that appropriate controls and procedures acceptable to LR are in place to control personnel access plugs and socket-outlets.

Table 15.5.1 Additional alarms and associated safeguards (*Part only shown*)

Item	Alarm	Note
Connection equipment tension	High	Emergency shut-down to be activated. *See* ~~5.3.7~~ 5.3.10.
Plug connectors	Withdrawal	
Connection cable, for connection ratings	Short-circuit	
Manual disconnection	Activation	
Plug and socket-outlet, if required. *See* 5.3.5	Not in locked position	
Switchgear enclosure mounted socket-outlets	Arc fault detection	

5.3.7 Where connection power plugs are connected to socket-outlets mounted on a switchgear enclosure, arrangements are to be provided to activate the Emergency Shut-Down facilities described in 5.3.2 in as short a time as practicable in the event of an arc occurring in the enclosure at the rear of the socket-outlets.

Existing paragraphs 5.3.5 *to* 5.3.7 *are to be renumbered* 5.3.8 *to* 5.3.10.

■ *Section 6*
Testing, trials and surveys

6.1 General

(*Part only shown*)
6.1.4 Trials are to be conducted when connected to a compatible external electrical power supply in accordance with 3.1.10 to demonstrate to the attending Surveyor that the Rules have been complied with in respect of:

(e) the operation of electrical load transfer arrangements (including Transfer Time Limit setting), electrical system protection and interlocking devices, Emergency Shut-Down arrangements and other safety devices and ship power restoration;

6.1.5 Arrangements are to be:

- examined at Annual Survey; and
- examined and functionally tested ~~within Special Survey cycles~~ whilst connected to an external electrical power supply during the Complete Surveys of machinery or, where this is not practical, within 12 months of the due date of the Complete Surveys of machinery.

This is to include examination of Connection Equipment.

Part 7, Chapter 17
Refrigeration Systems and Equipment Serving Provision Stores and Air-Conditioning Installations

Effective date 1 July 2009

■ *Section 1*
General requirements

1.1 General

1.1.1 This Chapter states the requirements for ships having centralised refrigeration systems, designed to reject heat from refrigerated stores or from the air-conditioning and ventilation arrangements fitted to both passenger and crew accommodation spaces and are in addition to the relevant requirements of Parts 5 and 6.

1.1.2. The requirements, which are optional, cover arrangements, equipment, and systems necessary for provision stores and air-conditioning arrangements as defined in 1.1.3 and 1.1.4.

1.1.3 The refrigeration system is to include the refrigeration compressor(s), condenser(s), evaporator(s), direct expansion air handling and fan coil units, interconnecting primary refrigerant piping system and fittings.

NOTE
For the purpose of these Rules, the term primary refrigerant system, unless otherwise stated, applies to primary refrigerant systems and secondary refrigerant systems containing volatile refrigerants.

1.1.4 These requirements are intended to mitigate risks associated with the safety of refrigeration and air conditioning machinery, and do not cover air distribution ductwork, chilled water systems or the calculation and verification of air flow rates and cooling loads within the air conditioned or refrigerated spaces. The method used to calculate the capacity of the air-conditioning refrigeration equipment is the responsibility of the Shipbuilder and Owner and should be in accordance with a recognised code or standard such as ISO 7547:2002 *Ships and marine technology – Air-conditioning and ventilation of accommodation spaces – Design conditions and basis of calculations* or, ASHRAE 26-1996(RA2006) *Mechanical Refrigeration and Air-Conditioning Installations Aboard Ship*.

1.1.5 Ships complying with the applicable requirements of this Chapter will be eligible for the optional machinery class notation **RPA** (Refrigeration Machinery for Provision Stores and Air-conditioning).

1.2 Plans and information

1.2.1 The following plans and particulars, as applicable, and any others which may be specially requested for the refrigerating plant and systems, are to be submitted in triplicate for approval, before construction is commenced:

(a) Schematic plans, including full particulars of piping and instrumentations, for:
  (i) primary and secondary refrigerant systems containing a volatile fluid;
  (ii) air cooler defrosting arrangements; and
  (iii) condenser cooling water systems.
(b) Detailed dimensioned plans and material specifications for:
  (i) reciprocating compressor crankshaft and crankcase, where exposed to refrigerant pressure;
  (ii) rotary-type compressor rotors and casing;
  (iii) condensers, both shell and tube, and plate type;
  (iv) evaporators, both shell and tube, and plate type;
  (v) air coolers or arrangement of air cooling pipe grids and construction method;
  (vi) liquid receivers;
  (vii) oil separators; and
  (viii) any other pressure vessels or heat exchangers containing primary refrigerants, *see* Pt 5, Ch 11,6.1.
(c) General arrangement of refrigerating machinery compartments in elevation and plan, showing location and arrangement of the plant, ventilation details and location of temperature sensors and refrigerant vapour detectors.
(d) Details of automatic controls, alarms and safety systems, *see* Pt 6, Ch 1,1.
(e) Details of primary refrigerant level indicators.
(f) Capacity calculations for pressure relief valves and/or bursting discs, and inlet and discharge pipework pressure drop calculations.
(g) Programme of tests to be conducted on completion of the installation, *see* Section 7.

1.2.2 In addition to the applicable requirements detailed in 1.2.1, the following information is also to be submitted for air-conditioning refrigeration equipment:

(a) Details of direct expansion fan coil units (FCUs).
(b) Details of cooling coils, fitted to air handling units (AHUs) that contain primary refrigerant.
(c) General arrangement drawing showing the location of the air-conditioning refrigeration equipment, direct expansion FCUs and AHUs throughout the ship.
(d) Details of pressure testing procedures for the refrigeration equipment.

1.2.3 Plans showing the general arrangement of refrigeration plant compartments, together with a description of the equipment and arrangements installed for isolation and distribution of ventilation air and the electrical power supply systems. The plans are to indicate segregation and access arrangements for compartments and associated control rooms and control stations.

1.2.4 A statement of the intended design system capacity for the intended operating conditions for verification purposes at the trials required by 7.2.1

1.2.5 A schedule of testing and trials to demonstrate that systems are capable of operating as designed and as required by Section 7.

1.2.6 Operating manuals are to be submitted for information. The manuals are to include the following information:

(a) Particulars and a description of the systems.
(b) Operating instructions for the equipment and systems.
(c) Maintenance instructions for the installed arrangements.

1.2.7 Evidence that the required performance of refrigeration systems, pump and fan equipment is capable of being maintained under ambient and inclination operating conditions defined in Pt 5, Ch 1,3.5 and 3.6 is to be provided by the manufacturer.

■ *Section 2*
Construction and installation

2.1 Materials

2.1.1 The selection of materials for piping systems in provision store refrigeration systems is to take account of the following:

(a) The pressures and temperatures of the refrigerant fluids.
(b) Locations of systems and equipment.
(c) Compatibility of materials.
(d) Fluid flow rates and static pressure conditions.
(e) Minimising corrosion and erosion through life of system.
(f) Refrigerant flammability and toxicity.

2.1.2 Pipes, valves and fittings are in general to be made of steel, ductile cast iron, copper, copper alloy, or other approved ductile material suitable for the intended purpose. The use of plastics materials is also acceptable subject to the restrictions in Pt 5, Ch 12,5

2.1.3 Where applicable, the piping systems are to comply with the requirements of Pt 5, Ch 12.

2.2 Equipment – Selection and installation

2.2.1 Pressure vessels in provision store and air conditioning refrigeration systems are to be in accordance with Pt 5, Ch 11 or an alternative recognised code acceptable to LR.

2.2.2 Valves and flexible hose lengths are to comply with the relevant requirements of Pt 5, Ch 12.

2.2.3 Pipes in piping systems are to be permanent pipes made with approved pipe connections to enable ready removal of valves, pumps, fittings and equipment. The pipes are to be efficiently secured in position to prevent chafing or lateral movement.

2.2.4 Suitable means for expansion are to be made, where necessary, in each range of pipes.

2.2.5 Suitable protection is to be provided for all pipes and equipment situated where they are liable to mechanical damage.

2.2.6 All moving parts are to be provided with guards to minimise danger to personnel.

2.2.7 Primary refrigerant pipework, serving AHUs and FCUs, which pass through bulkheads and deckheads is to comply with the requirements of SOLAS Chapter II-2, Regulation 9.3.

2.3 Valves and relief devices

2.3.1 Valves are to be fitted in places where they are readily accessible at all times.

2.3.2 Relief valves are to be adjusted and bursting discs so selected that they relieve at a pressure not greater than the design pressure of the system. When satisfactorily adjusted, relief valves are to be protected against tampering or interference by a locking wire with a lead seal or similar arrangement, *see also* 2.4.4.

2.4 Refrigerant systems

2.4.1 The primary refrigerants ammonia, hydrocarbons or carbon dioxide shall not be used in direct expansion FCUs located in accommodation spaces. The use of these refrigerants in machinery spaces, such as a separate AHU compartment, may be accepted subject to suitable safety arrangements being provided to the satisfaction of LR.

2.4.2 Compartments containing refrigeration plant are to be provided with refrigerant gas leak detectors with an alarm. *See* Section 4.

2.4.3 The design of refrigeration systems is to permit maintenance and repair without unavoidable loss of refrigerant to atmosphere. To minimise refrigerant release to the atmosphere, refrigerant recovery units are to be provided to allow evacuation of a system prior to maintenance.

2.4.4 Refrigeration systems are to be provided with relief devices which are arranged with sufficient margins to avoid circumstances that would allow an inadvertent discharge of refrigerant to the atmosphere. The system is to be so designed that over-pressure due to fire conditions can be safely relieved.

2.4.5 A pressure relief valve and/or bursting disc is to be fitted between each positive displacement compressor and its gas delivery stop valve, the discharge being led to the suction side of the compressor. The refrigerant flow capacity of the valve or disc is to exceed the full load compressor capacity for the particular refrigerant at the maximum potential suction pressure. For these internal relief valves, servo-operated valves will be accepted. Where the motive power for the compressor does not exceed 10 kW, the pressure relief valve and/or bursting disc may be omitted.

2.4.6 Each pressure vessel which may contain liquid refrigerant and which is capable of being isolated by means of a stop or automatic control or check valve is to be protected by two pressure relief valves or two bursting discs, or one of each, controlled by a changeover device. Pressure vessels that are connected by pipework without valves, so that they cannot be isolated from each other, may be regarded as a single pressure vessel for this purpose, provided that the interconnecting pipework does not prevent effective venting of any pressure vessel.

2.4.7 Omission of one of the specified relief devices and changeover device, as required by 2.4.6, will be accepted where:

(a) vessels are of less than 300 litres internal gross volume; or
(b) vessels discharge into the low pressure side of the system by means of a relief valve.

2.4.8 Sections of systems and components that could become full of liquid between closed valves are to be provided with pressure relief devices relieving to a suitable point in the refrigerant circuit.

2.4.9 Where any hermetic or semi-hermetic compressor has the electric motor cooled by the circulating refrigerant, the following arrangements are to be provided:

(a) Refrigeration circuits are to contain no more than one hermetic or semi-hermetic compressors.
(b) Each compressor motor is to be fitted with a thermal cut-out device to protect the motor against overheating.
(c) Each refrigerant circuit is to contain a suitable arrangement to allow debris or contaminants from a motor failure to be removed.
(d) The pressure envelope of any hermetic or semi-hermetic compressor exposed to the refrigerant pressure is to be designed and constructed in accordance with the requirements of Pt 5, Ch 11 and Pt 5, Ch 17 as applicable. Plans are to be submitted for consideration as required by Pt 5, Ch 11,1.6.

2.5 Air handling unit(s) (AHUs) for air conditioning systems

2.5.1 Evaporator coils as fitted to direct expansion AHUs are to be considered for approval and plans are to be submitted, *see also* 1.2.2. All other equipment fitted to an AHU, such as air filtration, dehumidification, heating and humidification systems are outside the scope of these Rules and are the responsibility of the Shipyard and Owner.

2.5.2 Each AHU is to be provided with suitable drip trays and drainage arrangements to remove any condensate which may form.

2.5.3 The installation arrangements of AHUs are to be such as to allow sufficient space for the withdrawal and replacement of the refrigerant cooling coil.

2.6 Air coolers and cooling grids for provision store refrigeration systems

2.6.1 Air cooler fan motors are to be suitably enclosed to withstand the effects of moisture.

2.6.2 Means are to be provided for effectively defrosting air coolers. Air coolers are to be provided with trays of suitable depth arranged to collect all condensate. The trays are to be provided with drains at their lowest points to enable the condensate to be drained away when the refrigerated spaces are in service. When a store operates at temperatures at, or lower than 0°C, provision is to be made for the prevention of freezing of the condensate.

2.6.3 The installation arrangements of air coolers are to be such that when the refrigerated spaces are loaded with provisions, adequate space is provided for the inspection, servicing and renewal of controls, valves, fans and fan motors.

2.6.4 Steel air cooler circuits and cooling grids are to be suitably protected against external corrosion.

2.7 Design pressures

2.7.1 The design pressure of the system will be regarded as equal to its maximum working pressure, *see* 2.7.5.

2.7.2 The maximum working pressure is the maximum permissible pressure within the system (or part system) in operation or at rest. No pressure relief valve or other protective device is to be set to a pressure higher than the maximum working pressure.

2.7.3 The design pressure of the low pressure side of the system is to be the saturated vapour pressure of the refrigerant at plus 46°C. Due regard is to be taken of defrosting arrangements which may cause a higher pressure to be imposed on the low pressure side of the system. For carbon dioxide design pressures, *see* 2.7.6.

2.7.4 The minimum design pressure of the high pressure side of the system (P_{dh}), is to be determined from 1,11 × P_b, where P_b is an allowance for the compressor high pressure cut-out. P_b is to be not less than to 1,11 × P_a, where P_a is the condenser working pressure, when operating in tropical zones and equates to the saturation pressure of the refrigerant at plus 46°C.

2.7.5 Design pressures applicable to refrigerants are to be not less than the values given in Table 17.2.1 when condensers are sea-water cooled. The design pressure for other refrigerants and condensing arrangements is to be agreed with LR.

2.7.6 The proposed design pressure for a carbon dioxide system is to be stated, taking account of the maximum working pressure and the maximum pressure at rest conditions. Where the maximum pressure at rest condition is maintained by the fitting of a supplementary refrigeration unit, condensing the vapour in a holding vessel, supporting calculation is to be provided to show that this can be undertaken with a local ambient temperature of 45°C. The holding vessel is to be thermally insulated to prevent the operation of the relief devices within a 24 hour period after stopping the supplementary refrigeration unit at an ambient temperature of 45°C and an initial pressure equal to the starting pressure of the refrigeration unit.

Table 17.2.1 Design pressure limits

Refrigerant	Pressure, (bar g)	
	High	Low
R-717	21.2	17.2
R-22	20,6	16,7
R-290	18,1	14,7
R-600a	6,4	5,2
R-134a	13,4	10,9
R-407C	23,5	19,0
R-410A	34,5	28,0
R-507A	25,3	20,5
R-404A	24,8	20,1
R-744	*See* 2.7.6	

NOTE
In view of increasing world-wide restrictive legislation and phasing out of the HCFC refrigerant R-22, it is recommended that this refrigerant should not be used in new installations.

2.7.7 Where a carbon dioxide system is designed for hot gas defrosting, due regard is to be given to the possibility of a higher pressure being imposed on the low pressure system. The design pressure for the hot gas defrosting section of the system is to be 10 per cent greater than the maximum pressure experienced during defrosting.

2.8 Insulation materials

2.8.1 Where applicable, having regard to their location and environmental conditions, insulation arrangements are to have:
(a) materials suitably resistant to fire;
(b) insulation lining suitably resistant to flame spread;
(c) effective protection against penetration of water vapour; and
(d) adequate protection against mechanical damage.

2.8.2 The potential for smoke generation and toxicity of insulation materials is to be in accordance with SOLAS Chapter II-2, Part B, Regulation 6.

2.8.3 Where the *in situ* foam type of insulation is proposed, full details of the process are to be submitted.

2.8.4 Prefabricated panel systems are to be fitted with suitable pressure equalizing devices.

2.8.5 All low temperature pipework, valves and fittings are to be provided with suitable thermal insulation. *See* Pt 6, Ch 3,4.11.10.

2.9 Manufacture and certification

2.9.1 Pressure vessels satisfying the conditions listed in Pt 5, Ch 11,1.6.1 are to be constructed in accordance with the requirements of Pt 5, Ch 11 and 17. Plans are to be submitted for consideration as required by Pt 5, Ch 11,1.6.

2.9.2 Other equipment, apart from applicable pressure vessels and heat exchangers, used for air-conditioning or provision stores refrigeration systems are not required to be constructed under survey.

2.9.3 All major items of equipment, containing refrigerant, such as compressors, condensers, AHU cooling coils and FCUs shall be supplied with a manufacturer's works certificate providing details of the design and test pressures.

■ *Section 3*
Refrigerating machinery and refrigerant storage compartment arrangements

3.1 General

3.1.1 Refrigerating machinery is to be installed in a well ventilated compartment. In general, the arrangements are to be such that all components of the refrigerating machinery can be readily opened up for inspection or replacement. Space is to be provided for the withdrawal and renewal of the tubes in 'shell-and-tube' type evaporators (secondary refrigerant coolers) and condensers. Proposals for alternative arrangements are to be submitted to LR for consideration.

3.1.2 Refrigerating machinery using toxic and/or flammable refrigerants is to be located outside the main machinery space in a separate gastight compartment.

3.1.3 Where the refrigerating machinery is located in a separate gastight compartment, outside the main machinery space, this compartment is to be equipped with effective mechanical ventilation to provide 30 air changes per hour based upon the total volume of the space. The mechanical ventilation system is to have two methods of control, one of which is to be operable from outside the compartment.

3.1.4 Openings for pipes, electrical cables and other fittings in bulkheads and decks are to be fitted with gastight seals.

3.2 Gas storage compartments

3.2.1 Portable steel cylinders containing reserve supplies of refrigerant are to be stored in a well ventilated compartment reserved solely for this purpose.

3.2.2 The storage compartment is to be provided with a mechanical ventilation system providing 10 air changes per hour.

3.2.3 The storage compartment is to be provided with a suitable vapour detection system, *see* Section 4.

3.2.4 The storage compartment is to be provided with suitable water drainage arrangements not connected with the main machinery spaces.

3.2.5 Steel storage cylinders are to be of an approved type and are to be filled to a level suitable for an ambient temperature of plus 46°C.

3.2.6 The storage compartment is to be provided with racks to facilitate secure stowage of the cylinders.

3.3 Pressure testing at manufacturers' works

3.3.1 Components intended for use with a primary refrigerant are to be subject to pressure testing procedures as detailed in Table 17.3.1.

Table 17.3.1 Test pressure

Component	Test pressure, (bar g)	
	Pressure test	Tightness test
(1) Pressure vessels	*See* Pt 5, Ch 11	1,0*p*
(2) Compressor cylinders/ crankcase/casing	1,5*p*	1,0*p*
(3) Valves and fittings	2,0*p*	1,0*p*
(4) Pressure piping, fabricated. headers, air coolers, etc.	1,5*p*	1,0*p*
NOTE *p* is the design pressure as defined in 2.7.		

3.3.2 Component pressure tests are to be hydraulic or where suitable safety measures are taken, may be pneumatic. The latter is to be carried out with a suitable dry inert gas.

3.3.3 Component tightness tests are to be carried out only after completion of satisfactory pressure tests. Pneumatic pressure is to be applied using a suitable dry inert gas.

3.3.4 Components for use with a secondary refrigerant or cooling water are to be hydraulically tested to 1,5 times the design pressure which, in no case is to be less than 3,5 bar g.

3.4 Pressure test after installation on board ship

3.4.1 For primary refrigerant piping welded in place, pressure tests of the welds are to be carried out at a test pressure of 1,5*p*. This will normally take the form of a pneumatic test (*see* 3.4.2) since hydraulic testing media such as water are not acceptable due to their incompatibility with the primary refrigerants and the difficulty of removing all traces from a completed system.

3.4.2 Pneumatic pressure tests are to be carried out using a suitable inert gas.

NOTE
Where pneumatic testing is used, adequate safety precautions recognising the hazards involved should be observed to prevent danger to personnel and to minimise risk to property.

3.4.3 Where pneumatic tests are prohibited by relevant authorities, the tests required by 3.4.1 and 3.4.2 may be omitted provided non-destructive examination has been carried out by an approved operator to the satisfaction of LR and in accordance with the requirements of Pt 5, Ch 17,7.

3.4.4 After completion of the test required by 3.4.1, 3.4.2 or 3.4.3, a tightness test is to be carried out using a suitable inert gas at a pressure equal to the design pressure, in the presence of the surveyor.

3.4.5 Secondary refrigerant piping welded in place is to be hydraulically tested to 1,5 times the design pressure which, in no case is to be less than 3,5 bar g.

■ *Section 4*
Refrigerant detection systems

4.1 General

4.1.1 A fixed refrigerant detection system is to be provided in the refrigerating machinery compartment or space and ventilation outlet ducts when the ventilation system is shared with other compartments.

4.1.2 The alarm system is to comply with the requirements of Pt 6, Ch 1 and, as a minimum requirement, the system is to activate at a low-level concentration to give warning of refrigerant leaks, and at a high-level concentration corresponding to the refrigerant's safe occupational level.

4.1.3 Detection equipment is to be so designed that it may be readily tested and calibrated; any failure of the equipment is to initiate an alarm.

4.1.4 The location of the detectors is to be determined relative to the layouts of the individual compartments and machinery spaces and are to be indicated in the plan submission.

4.1.5 Audible and visual alarms are to be activated, located both inside and outside the affected space. The alarms are to be readily identifiable and be visible and audible in all locations within the space housing the refrigeration equipment.

■ *Section 5*
Control and monitoring and electrical power arrangements

5.1 General

5.1.1 Control engineering arrangements are to comply with Pt 6, Ch 1 as applicable.

5.1.2 All cooling and secondary refrigerant pumps are to be provided with an indication of discharge pressure and a low discharge pressure alarm at each control station.

5.1.3 The power to all independently driven ventilation fans is to be capable of being stopped from position(s) outside the fire boundary which will remain readily accessible in the event of fire occurring in any space, as well as from the local control panel.

5.1.4 Electrical engineering arrangements are to comply with Pt 6, Ch 2.

5.1.5 Refrigeration compressors are to be provided with the following instrumentation and automatic shutdowns:

(a) Indication of suction pressure (saturated temperature), including intermediate stage when applicable.
(b) Indication of discharge pressure (saturated temperature), including intermediate stage when applicable.
(c) Indication of lubricating oil pressure.
(d) Indication of cumulative running hours (screw compressors).
(e) Automatic shutdown in the event of low lubricating oil pressure.
(f) Automatic shutdown in the event of high discharge pressure, *see also* 5.1.13.
(g) Automatic shutdown in the event of low suction pressure.

5.1.6 For refrigeration compressors greater than 25 kW, the following instrumentation, additional to that required by 5.1.5, is to be provided:

(a) Indication of lubricating oil temperature.
(b) Indication of condenser cooling water outlet temperature.
(c) Indication of cumulative running hours (reciprocating compressors).
(d) Indication of suction and discharge temperatures.

5.1.7 Alarms are to be initiated in the event of the following fault conditions with refrigeration compressors:

(a) High discharge pressure.
(b) Low suction pressure.
(c) Low oil pressure.
(d) High discharge temperature.
(e) High oil temperature.
(f) Motor shutdown.

5.1.8 Refrigeration plants are to be provided with the following alarms as applicable:

(a) Failure of condenser cooling water pumps.
(b) High condenser cooling water outlet temperature.
(c) Failure of air cooler fans.
(d) High and low refrigerated air delivery temperatures.
(e) High secondary refrigerant temperatures.
(f) Failure of secondary refrigerant pump.
(g) Low level in secondary refrigerant header tank.

5.1.9 Where the air-conditioning/refrigerating system is fitted with automatic or remote controls, so that, under normal operating conditions, no manual intervention by the operators is required, it is to be provided with the alarms required by 5.1.6 to 5.1.8 in accordance with the relevant requirements of Pt 6, Ch 1.

5.1.10 Where more than one compressor is fitted, the control sequence is to be such as to allow one machine to stop in the event of a reduction in cooling duty. Provision is to be made to allow selection of the lead machine to equalise running hours.

5.1.11 To allow the equipment to be isolated from the power supply in the event of a failure or refrigerant leak, refrigeration compressors and AHUs are to be fitted with local emergency stop switches.

5.1.12 AHUs are to be provided with the following instrumentation as a minimum:
(a) Indication of primary refrigerant outlet pressure and temperature; and
(b) Indication of outlet air temperature.

5.1.13 Compressors are to be provided with automatic shutdown in the event of high discharge pressure. For refrigeration systems where the maximum working pressure is less than or equal to 40 bar g, the automatic shutdown is to operate at a pressure in excess of normal operating pressure but no greater than 0,9 of the maximum working pressure. For refrigeration systems where the maximum working pressure is greater than 40 bar g, the automatic shutdown is to operate at a pressure in excess of normal operating pressure but no greater than 0,95 of the maximum working pressure.

■ *Section 6*
Personnel safety equipment and systems

6.1 Personnel safety equipment

6.1.1 Access doors to the refrigerated spaces are to open outwards, alternatively sliding doors may be used where the door is external to the space.

6.1.2 Access ways to the refrigerated spaces are to be designed to facilitate escape in emergencies, and the removal of stretcher-borne personnel.

6.1.3 Access ways and refrigerated compartments are to be provided with an independent lighting system in accordance with the requirements of Pt 6, Ch 2,5.7.2 and 5.7.4, with the means of locking the switches in the 'on' position.

6.1.4 Arrangements are to be such that means are provided for both opening the room door(s) and sounding the alarm required by 6.2.2 from inside refrigerated spaces.

6.1.5 Where ammonia is used in refrigerating systems, the following items of safety equipment are to be provided as a minimum, and positioned in accessible protected storage (e.g. locked glass fronted cabinets) located outside the machinery compartment:
(a) Two sets of ammonia protective clothing (including helmet, boots and gloves).
(b) Two portable battery powered hand lamps (to be of certified safe-type).
(c) Two sets of self-contained breathing apparatus (compressed air).
(d) Two full face mask respirators.
(e) Two fire-resistant life-lines.
(f) Two firemen's axes.
(g) Two heavy duty adjustable spanners.
(h) Two wheel wrenches.
(j) Irrigation facilities or eye wash bottles containing an eye wash solution, distilled water or non-carbonated mineral water.
(k) Hand or foot-operated douches providing a copious supply of clean water, located outside the compartment's doors.

6.2 Personnel warning systems

6.2.1 A system to monitor the well-being of crew members entering refrigerated spaces is to be provided.

6.2.2 The system is to be such that at a predetermined time, after initiation, the crew member(s) receives warning that the system is to alarm and must indicate their well-being by accepting the warning.

6.2.3 The system is to be designed and arranged such that only an authorised person has access for enabling and disabling it and setting the appropriate intervals, and such that it cannot be operated in an unauthorised manner.

6.2.4 It is to be possible to acknowledge the warning by means of illuminated switches situated near the access doors or hatches of each refrigerated space or chambers within the space.

6.2.5 In the event that the crew member(s) fails to respond and accept the warning within an agreed specified time, the system is to immediately initiate an alarm on the bridge and at the main control station, or subsidiary control stations as appropriate. Manual initiation of the alarm system from the refrigerated spaces is to be possible at any time.

6.2.6 The system is to comply with the relevant requirements of Pt 6, Ch 1.

■ *Section 7*
Testing and trials

7.1 Testing

7.1.1 The requirements of the Rules relating to testing of pressure vessels, piping and related fittings including hydraulic testing are applicable. *See* Pt 5, Ch 11 and Ch 12,8.

7.1.2 On completion, tanks and reservoirs for service and storage of system fluids are to be tested by a head of water equal to the maximum to which the tanks may be subjected, but not less than 2,5 m above the crown of the tank.

7.1.3 After installation on board, piping systems together with associated fittings that are under internal pressure, are to be subjected to a running test at the intended maximum working pressure.

7.1.4 Testing is to cover the following items:

(a) Verification of control, alarm and safety systems.
(b) Simulation tests for failure of refrigeration equipment, to verify correct functioning of alarms and systems in service.
(c) Verification of accuracy, calibration and functioning of temperature control for refrigeration systems.

7.2 Trials

7.2.1 Acceptance trials, as stipulated in this Section, are to be conducted. It is to be demonstrated that the provision store or air-conditioning refrigerating system capacity meets the design duty. As far as is practicable, the trials are to represent the operating conditions that will be encountered in service. For example, the condenser cooling water flow should be restricted so that the compressor discharge pressure is at the design value.

Cross-References

Section numbering in brackets reflects any Section renumbering necessitated by any of the Notices that update the current version of the Rules for Ships.

Part 5, Chapter 13

Section 2 Cross-reference	*Reference* Ch 12,9 *now reads* Ch 12,10.

Part 5, Chapter 14

Section 7 Cross-reference	*Reference* Ch 12,9 *now reads* Ch 12,10.

Part 6, Chapter 1

2.9.6 (*now* ***2.9.8***)	*Reference* 2.9.7 to 2.9.12 *now reads* 2.9.9 to 2.9.12.
2.9.8 (*now* ***2.9.11***)	*Reference* 2.9.4 *now reads* 2.9.5.

Part 6, Chapter 2

1.2.1	*Reference* 1.2.14 to 1.2.17 *now reads* 1.2.15 to 1.2.18.
1.2.13 (*now* ***1.2.14***)	*Reference* 10.8.8 *now reads* 10.8.10.
10.8.19 (*now* ***10.8.21***)	*Reference* 10.5.6 *now reads* 10.5.7.
10.14.1	*Reference* 1.10.6 *now reads* 1.10.7.

Part 7, Chapter 10

7.1.7	*Reference* Pt 5, Ch 12,9.8 *now reads* Pt 5, Ch 12,10.8.

Part 7, Chapter 15

1.4.5	*Reference* 3.3.7 *now reads* 3.3.8.
1.4.7	*Reference* 3.3.5 *now reads* 3.3.6.
4.2.1	*Reference* Pt 6, Ch 2,1.2.16 *now reads* Pt 6, Ch 2,1.2.17.
Table 15.5.1	*Reference* 5.3.7 *now reads* 5.3.10.

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